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tial backoff, wherein after a certain number of increases, the transmission timeout reaches a ceiling and thereafter does not increase any further.

[0103] According to an example embodiment, it may also be possible to start data transmission directly without RTS-CTS signaling and in that case, the first packet carries information similar to the RTS to start protection.

[0104] IEEE 802.11 wireless devices normally employ Carrier Sense Multiple Access (CSMA), wherein a spectrum sensing capability is used during an interval like the SIFS interval, DIFS interval or AIFS interval, to detect whether the channel is busy. A carrier sensing scheme may be used wherein a node wishing to transmit data has to first listen to the channel for a predetermined amount of time to determine whether or not another node is transmitting on the channel within the wireless range. If the channel is sensed to be idle, then the node may be permitted to begin the transmission process. If the channel is sensed to be busy, then the node may delay its transmission for a random period of time called the backoff interval. In the DCF protocol used in IEEE 802.11 networks, the stations, on sensing a channel idle for DIFS interval, may enter the backoff phase with a random value between 0 and CWmin. The backoff counter may be decremented from this selected value as long as the channel is sensed idle. Binary exponential backoff may be used to randomly delay transmissions, in order to avoid collisions. The transmission may be delayed by an amount of time that is the product of the slot time and a pseudo random number. Initially, each sender may randomly wait 0 or 1 slot times. After a busy channel is detected, the senders may randomly wait between from 0 to 3 slot times. After the channel is detected to be busy a second time, the senders may randomly wait between from 0 to 7 slot times, and so forth. As the number of transmission attempts increases, the number of random possibilities for delay increases exponentially.

[0105] The mobile device that starts an ad hoc network will begin by resetting its TSF timer to zero and transmitting a Beacon, choosing a beacon period, which establishes the basic beaconing process for this ad hoc network. After the ad hoc network has been established, each device in the ad hoc network will attempt to send a Beacon after the target beacon transmission time (TBTT) arrives, choosing a random delay value to avoid collisions. Each device in a beacon group receives a beacon including timing synchronization of the beacon group of which the device is a member. The synchronized devices in the beacon group should be simultaneously available during a discovery interval to listen for and to exchange messages. Discovery intervals may be aligned with TBTTs. The beginning of a discovery interval may be aligned with a TBTT or alternatively, a discovery interval may be deemed to start upon reception or transmission of a beacon after a TBTT.

[0106] 5. Synchronization

[0107] Synchronization is the process of the devices in an ad hoc network getting in step with each other, so that reliable communication is possible. The MAC may provide the synchronization mechanism to allow support of physical layers that make use of frequency hopping or other time-based mechanisms where the parameters of the physical layer change with time. The process may involve beaconing to announce the presence of an ad hoc network, and inquiring to find an ad hoc network. Once an ad hoc network is found, a device may join the ad hoc network. This process may be entirely distributed in ad hoc networks, and may rely on a common timebase provided by a timer synchronization function (TSF). The TSF may maintain a 64-bit timer running at 1 MHz and updated by information from other devices. When a device begins operation, it may reset the timer to zero. The timer may be updated by information received in beacon frames.

[0108] Since there is no AP, the mobile device that starts the ad hoc network may begin by resetting its TSF timer to zero and transmitting a beacon, choosing a beacon period. This establishes the basic beaconing process for this ad hoc network. After the ad hoc network has been established, each device in the ad hoc network will attempt to send a beacon after the target beacon transmission time (TBTT) arrives. To minimize actual collisions of the transmitted beacon frames on the medium, each device in the ad hoc network may choose a random delay value which it may allow to expire before it attempts its beacon transmission.

[0109] Once a device has performed an inquiry that results in one or more ad hoc network descriptions, the device may choose to join one of the ad hoc networks. The joining process may be a purely local process that occurs entirely internal to the mobile device. There may be no indication to the outside world that a device has joined a particular ad hoc network. Joining an ad hoc network may require that all of the mobile device's MAC and physical parameters be synchronized with the desired ad hoc network. To do this, the device may update its timer with the value of the timer from the ad hoc network description, modified by adding the time elapsed since the description was acquired. This will synchronize the timer to the ad hoc network. The BSSID of the ad hoc network may be adopted, as well as the parameters in the capability information field. Once this process is complete, the mobile device has joined the ad hoc network and is ready to begin communicating with the devices in the ad hoc network.

[0110] 6. Quality of Service (QoS)

[0111] The Quality of Service (QoS) support in the IEEE 802.11 WLAN protocol is provided by access categories (ACs) and multiple independent backoff entities. The Quality of Service (QoS) support defines the MAC procedures to support local area network (LAN) applications with quality of service (QoS) requirements, including the transport of voice, audio, and video.

[0112] Packets are delivered by parallel backoff entities operating within the same WLAN device, where backoff entities are prioritized using AC-specific contention parameters. There are four access categories (ACs) and thus, four backoff entities exist in every WLAN device. The AC-specific contention parameters are labeled according to their target application: AC_VO for voice or audio packets, AC_VI for video packets, AC_BE for packets whose delivery is on a best effort basis, and AC_BK for background packets. The four access categories (ACs) define the priorities in accessing the medium by setting individual interframe spaces, contention windows, and other medium access parameters per access category (AC).

[0113] Contention-based medium access is performed in every backoff entity by using different parameter values for the AC-specific contention parameters. The AC-specific contention parameters are announced via information fields in beacon frames. The same AC-specific contention parameters are used by the backoff entities different WLAN devices in the network.

[0114] Each backoff entity within a WLAN device independently contends for a transmit opportunity (TXOP) of a